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ABSTRACT

In order to assess the validity of the relationship of motor skills to academic progress, 20 children from 3 different socioeconomic areas were studied, psychologically, neurologically and sociologically. Their intelligence and school progress were found to follow socioeconomic lines. Neurological status as tested by a scored "extended" neurological assessment failed to show any relationship to academic achievement, however. Medical and sociological information proved to be more important when the factors surronunding parental education, and the history of the mother's pregnancy and labor and the child's neonatal period, were studied. (Author/SET)

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THE COMPARATIVE NEUROLOGICAL, PHYSICAL AND SOCIOLOGICAL STATUS OF GRADE 1 CHILDREN IN THREE SOCIO-ECONOMIC AREAS.

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THE COMPARATIVE NEUROLOGICAL, PHYSICAL AND SOCIOLOGICAL STATUS OF GRADE 1 CHILDREN IN THREE SOCIO-ECONOMIC AREAS

INTRODUCTION:

Some children with learning problems will have subtly abnormal neurological findings, although they do not have overt neurological disease (1,2.) Without controlled studies this fact has lent itself to over-interpretation, and programs, aimed at training sensory and motor skills, have been promoted as a way of helping children improve their school performance. (3,4.)

A controlled study was, therefore, undertaken, the main goal being an attempt to clarify the relationship between neurological status and intelligence, and between neurological status and reading ability. In addition, the relationship between the physical and sociological status of the child and his intelligence was determined. From these findings, the physician's area of responsibility in children's learning problems was determined.

METHOD

Three socio-economic (S.E.) areas differing significantly - according to the Blishen index (5) were chosen for study. Twenty children were first selected at random from the Grade 1 classrooms in the school in the low socio-economic area. These children were then matched for sex and age at two other schools, one in a middle and one in a high S.E. area. These 60 children were examined as follows:

A. Psychological Examination

The 60 children had been included in a larger study, involving all beginners in the three S.E. areas, and a psychological test battery had been administered prior to school entry. This evaluation included appraisal of general school readiness, intelligence level, visual, auditory and kinaesthetic perceptual skills as well as vocabulary and visual motor co-ordination. (5,6,7,8,9,10.)

At the end of the first school year, the Schonell word recognition scale (11) was administered as a criterion of progress. The child's reading from this word list indicates how well the child has mastered the basic skills underlying word recognition. This measure of progress was validated by means of reference to group tests of basic skills (12,13.)

B. Medical and Sociological Information from the Mother

a Past family history of medical, learning or emotional problems. (The emphasis was on the child's development and behavior within the family complex.)

b. Educational status of the parents and siblings.

c. Complications related to pregnancy, labor, birth and the neo-natal period.

d. Developmental milestones of the child (i.e. walking, talking, toilet training.)

e. Review of systems for symptoms of acute or chronic disease.

C. General Physical and Neurological Exam nation.

Each child's height, weight and head circumference were recorded. A limited physical examination was done. This was related to symtoms revealed during the history taking, but always included a complete neurological examination, recording muscle tone and strength, reflexes, sensation, as well as visual acuity and hearing.

D. Extended Neurological Examination, as devised by Ozer (14.) This particular assessment records results by means of a scoring system. Some additions were made (16.) The extended neurological examination focused on:

1. Cerebral Dominance

   a. Child's understanding of right and left on himself and on the person facing him (14,16,17.)

   b. Child's ability to follow directions relative to crossing the midline (14.)

   c. Natural or innate handedness or footedness of the child (14,15) as well as the hand and foot preferred in everyday activities.

   d. Eye dominance determined by the pinhole test, that is, a small square of paper with a pin sized hole was given to the child with the instructions "see if you can see through the tiny hole." The paper was turned over and the child asked to "look again from the other side of the paper."

2. Motor Skills

   The childs ability to follow simple commands with minimal emphasis on verbal directions and accompanied by demonstration (14.) For example, the examiner says "stand like this with your hands at your sides and then tap your foot as I do until I tell you to stop." The numbers of taps of the foot are counted, the quality and synchronization of the tapping is noted, as are the numbers of associated movements the child makes during the tapping. These various factors all affect the scoring. If a child could perform on such a test as well as the examiner, he was given a score of 3 points. Twenty such tests gave a perfect motor score of 60 points.

3. Sensory Skills

   a. Superficial sensation. Touch and pain were tested during the general neurological examination. Temperature sensation was not tested.

   b. Proprioceptive sensation. This was tested using position sense (little finger (14) and great toe.)

4. Cortical Sensory Functions

   a. Twopoint discrimination (14)
   b. Stereognosis (2)
   c. Graphaesthesia (tactile figure writing) (14)
   d. Displacement or extinction of tactile stimuli (14) (face-hand test)
   e. Special senses i Vision

      Snellen eye Chart
      Cover test
      Optokinetic nystagmus (14)
      Figure ground testing and color appreciation using the 1 AO HRR pseudo-isochromatic plates (14)

      ii. Hearing

      Tuning forks
      Audiometry
      Sound-touch test as a measure of distractibility (14)

5. Other neurological tests

   a. Arm extension (15)
   b. Finger recognition (18, 19.)
   c. Imitation of gestures (15)

The child's ability to co-operate and learn from repetition affected his scoring in many of the tests of both motor and sensory areas.

RESULTS AND DISCUSSION

The data were compiled and analyzed whenever possible by chi-square techniques.

A. Psychological Testing.

Table i shows the performance of the three groups of twenty children on selected tests from the pre-school battery. The differences in the mean scores of children

from each of the three S.E. groups are highly significant.

B. Medical and Sociological Information

1. Maternal and Paternal Age. Mothers in the low S.E. group and fathers in the middle S.E. group were the youngest. The oldest mothers and fathers were in the high S.E. group but the differences were not significant.

2. Maternal and Paternal Education. There was a significant difference in the educational level of the mothers from the three areas, and this also was true of the fathers. In the low S.E. group only 4 mothers and 5 fathers finished high school and there were 6 mothers and 2 fathers who had no better than a Grade 6 education.

3. Complications of pregnancy, labor and neonatal period were more frequent in the low S.E. group (Table 3). Six children in the low S.E. group were premature by weight and/or dates. There were no children with birthweight less than 2500 grams in the middle S.E. group and only one in the high.

   The reported complications were difficult to classify as to severity or significance, on the basis of the mother's history. Many were probably insignificant, such as reportedly "long" or "short" labors, minor indispositions during pregnancy, etc. More important complications were as follows:

Low S.E. area	2 toxemias requiring hospitalization 2 precipitate labors under 1 hour 1 severe anemia during pregnancy requiring transfusion 6 premature and/or low birth weight 3 multiple births 1 cesarian section (14 minor complications)
Middle S.E. area	1 premature rupture of membranes 1 cesarian section 1 "painless" labor, probably precipitate (15 minor complications)
High S.E. area	1 breech birth 1 high forceps delivery 1 premature birth (11 minor complications)

The greatest number of major complications were reported by mothers in the low S.E. area.

The number of mothers who reported "definitely no problems" during pregnancy, labor or the neonatal period are also listed in Table 3. The I.Q.'s of their children are contrasted with the I.Q's of the children whose mothers reported "complications", in Table 4.

In the low and high S.E. groups, the difference in I.Q. was significant at $p < .01$ and $p < .05$ respectively. Contrasting the whole group of 19 children whose mothers reported "no complications" with the 41 whose mothers reported "complications", the difference in I.Q. was highly significant at $p < .001$.

4. Prematurity. The incidence of prematurity was greatest in the low S.E. area with 6 of the 20 children (30%) being premature by weight (under 2500 gms). In the large research group which included all beginners in the three S.E. areas, the incidence was 25%. Five of the 6 prematures in the low S.E. group weighed more than 2000 gms and all weighed more than 1500 gms The premature in the high S.E. group weighed 1077 gms. There were no prematures in the middle S.E. group, and only one in the high S.E. area. A statistical statement cannot, therefore, be made about prematurity in these two areas. In the low S.E. area, the prematures tended to have lower I.Q.'s (and reading ascores) but the differences were not statistically significant. (Table 5) However, when all 7 prematures were contrasted with the 53 non-prematures, the I.Q.'s were significantly different.

5. Health. In reply to leading questions, mothers in the low S.E. group reported the greatest number of symptoms of ill-health in their children. These symptoms were related to the respiratory, urinary or gastro intestinal systems. There were almost as many complaints from the mothers in the middle S.E. group but quite frequently the mother's only comment was that the child was "high-strung." The high S.E. group had the fewest complaints about health problems. The greatest number of abnormal physical findings was in the low S.E. group. (Table 6)

6. Developmental milestones. The mother's history was of questionable accuracy. However, the largest number giving a consistent history of precocious speech development was in the high S.E. group, where 16 children were reported to be using sentences before the age of 2 years, as opposed to 10 in the low S.E. group. In contrast, the greatest number of children reported to be walking by 1 year of age came from the low S.E. group. Only 2 mothers in the high S.E. group recorded toilet training success at the age of 18 months or younger as opposed to 7 in the low S.E. group.

C. Physical and gross neurological findings.

1. Size. The average height, weight and head circumference in the three S.E. areas as well as I.Q.'s and Schonell reading scores are recorded in Table 7.

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The children in the high S.E. group were the tallest, the heaviest and have the largest head circumferences. All dimensions were found to be larger, the higher the SE. level. The differences were not significant, however. Because of this seeming relationship between size and S.E. level, correlations between size, intelligence and reading ability were made for the whole group. (Table 8) In spite of the slightly larger head sizes of the high S.E. group, I.Q. and head circumference showed a correlation of only .12.

2. Traditional Neurological Examination. There were 6 children with minor neurological findings as follows:

Hyperreflexia	3
Hyptonia	2
Unusual movements	1
Hyperactivity	2
Retinal pigmentation	1

These 6 children were equally dispersed among the three S.E. groups. One child who had been a premature baby was hyperactive and had brisk reflexes. The other neurological findings were unexplained.

3. Vision. There were children in the low S.E. area who had 20/20 vision but only 6 in the middle and 9 in the high. Premature children all had vision of 20/40 or better.

4. Hearing. Three children in the low S.E. area had low tone hearing losses greater than 30 decibels. One child in the high S.E. group had a high tone hearing loss of 40 - 50 decibels in the frequencies above 1000. This loss was thought to be associated with hyperbilirubinemia.

D. Results of Extended Neurological Examination

1. Cerebral Dominance.

a. Mixed hand-eye dominance was found in approximately 1/3 or the children in each S.E. group. Children with mixed hand-eye dominance were equally as intelligent as those with ipsi-lateral dominance and read just as well.

b. Mixed hand-foot dominance was found in 10 of the 60 children. These children had average motor scores and rather superior school achievement.

c. There were 12 left handed children whose intelligence and reading ability equalled that of the right handed children.

2. Right left orientation and crossing the midline of the body. The scores showed no relation to S.E. status, I.Q or reading ability.

3. Motor and sensory testing.

The total motor score and some of the scores of the sensory and other tests are shown in table 9. These scores reveal no characteristic pattern or deficiency relative to the S.E. group as was found in the psychological testing.

The motor scores followed a normal distribution curve. Eight children had motor scores which were more than one standard deviation below the mean and seven had scores that were more than one standard deviation above the mean.

The average I.Q. of the 8 children below the mean was 99.25 which is significantly lower then the average I.Q. of the other 52 children (114.34). However, the average reading score of these 8 children was 16.5 which was not significantly lower than the reading score for the other 52 children (20.04).

Because of these findings the relationship between motor score, I.Q. and Schonell word recognition test was subject to statistical analysis, for the group as a whole. Multiple correlation showed that the combined effect of motor score and I.Q. alone correlates with the Schonell criterion score at .65. However, I.Q. alone correlates with the Schonell score at .64. Therefore, motor skills have only a minor influence on subsequent reading ability as evidenced by the Schonell scores.

It was noted that for any one child, neither the motor score nor any other scores of the extended neurological proved to be consistently helpful in indicating intelligence or achievement in reading. For instance, 8 children each with a motor score of 48 ranged in I.Q. from 87 to 142 and their Schonell reading scores ranged from 10 to 31.

The sensory scores showed no relationship to S.E. level, I.Q. or school achievement.

SUMMARY OF RESULTS

1. Psychological findings.

Intelligence and scholastic achievement varied directly with S.E. status. Differences in test results were statistically significant.

2. Medical and Sociological information.

The differences in both paternal and maternal education were significant between the three S.E. groups, as were the numbers of complications associated with pregnancy, labor and neonatal period. The children in each S.E. group whose mothers reported definitely "no complication" of pregnancy, labor or the neonatal period, had higher average I.Q.'s than the others, and for the whole group, the difference was highly significant. Although the premature children were included in the group whose mothers reported complications, prematurity alone did not significantly affect intelligence, in the low S.E. group.

Mothers in the low S.E. group reported earlier walking but later talking.

3. Physical findings.

There was evidence to suggest a relationship between general health and S.E. status. Heights, weights and head circumferences varied directly with S.E. standing but the differences were not statistically significant. The correlation between head circumference, intelligence and reading ability was very low, however.

4. Neurological findings.

Low motor scores and low I.Q.'s seem to have some association. The motor score accounts for only 1% of the variability of the Schonell reading scores. None of the neurological scores showed any significant differences relative to IQ, reading ability or SE status

CONCLUSIONS:

1. Psychological testing has shown that intelligence, and achievement in reading are related to the S.E. area. Neurological status, however, was not found to be significantly different in the three S.E. groups. In spite of some relationship between low motor scores and low I.Q. in a small group of children, statistical correlation was not significant for the whole group. Low motor scores were not significantly related to low reading scores.

Apparent associations made by some observers between gross motor skills and reading ability have been used as a basis for motor training, aimed at upgrading reading skill. The findings in this study provide no support for such programs.

2. Parental education, maternal health during pregnancy, frequency of complications of labor and the child's neo-natal period, as well as the child's general health and physical measurements, all follow along S.E. levels. This study suggests the importance of these factors relative to intelligence and academic achievement.

3. Neurological assessment is not the most important aspect of the Physician's role in dealing with childrens' learning problems. More important would be his endeavours relative to improved obstetrics and neonatal care, and the supervision of nutrition and the general health of children. Poor school achievement seems highly predictable where there is a combination of high risk characteristics (of pregnancy, birth and the neonatal state) and low S.E. status.

ABSTRACT:

So called "soft" neurological signs and co-ordination problems have been found by some observers to occur with greater frequency in children with learning problems, and programs have been devised to treat the child's learning problems by motor training. In order to assess the validity of this relationship of motor skills to academic progress, 20 children from 3 different socio-economic areas were studied, psychologically, neurologically and sociologically and their intelligence and school progress were found to follow along S.E. lines. Neurological status as tested by a scored "extended" neurological assessment failed to show any relationship to academic achievement, however. Medical and sociological information proved to be more important when the factors surrounding parental education, and the history of the mother's pregnancy and labor and the child's neonatal period, were studied. The Doctor's most important role in childrens' learning problems may well be a general medical or obstetrical one rather than neurological.

BIBLIOGRAPHY

1. Lucas, Alexander, Rodin Ernst A, Simpson Clyde B. Neurological Assessment of Children with Early School Problems. Devel. Med. Child Neurol. 7: 145 - 156 April 1965

2. Paine, Richmond S and Oppe, Thomas E. Neurological Examination of Children 1966

3. Kephart, N.C. The slow learner in the classroom. Columbus, Ohio. Merrill 1960

4. Delacato, C.H. The treatment and prevention of reading problems. The neuropsychological approach. Springfield, Ill. Charles C. Thomas 1959

5. Blishen, B.R. A socio-economic index for occupations in Canada. The Canadian Review of Sociology and Anthropology 1967 4, 41 - 53.

6. Terman, L.M., and Merrill, M.A. Stanford-Binet Intelligence Scale (3rd Rev) Boston Houghton-Mifflin 1960

7. Bender L. A visual-motor Gestalt test and its clinical use. American Orthopsychiatric Association Research Monograph, 1938, No. 3.

8. Hooper R.E. The Hooper Visual-Organization Test. California: Western Psychological Service, Inc. 1957

9. Goodenough, F.L. The Measurement of Intelligence by Drawing. World Book Co., 1926

10. McGahan, F.E. and McGahan, Carolyn. The Early Detection Inventory, Chicago: Follett Educational Corporation, 1967

11. Schonell, Fred. The psychology and Teaching of Reading. London: Oliver and Boyd 4th Ed. 1961

12. Gates, Arthur I and McGimtie, Walter H. Gates McGimtie Reading Tests. Teachers' Manual. New York: Teachers College press, Columbia University, 1965

13. Co-operative Primary Mathematics, Form 12A Handbook Co-operative Primary Tests. Educational Testing Service, Princeton, New Jersey, 1967.

14. Ozer, M.M., A measure for neurological evaluation of school age children. Presented at a Seminar on learning difficulties at the Children's Hospital, Washington, D.C. May 1967.

15. Whitsell, Leon J. Useful tests in Neurological Examination of School Age Children. Presented at American Academy of Pediatrics, San Francisco, California. April 5 1967.

16. Lillian Belmont and Herbert Birch. Lateral Dominance, Lateral Awareness and Reading Disability. Albert Einstein College of Medicine: Child Devt. Vol. 36 Page 1965.

17. Cerebral Dominance and its Disturbances. Benson D. Frank M.D. and Norm Geschwind M.D. Ped. Cl. N. America Vol 15 No. 3. August 1968.

18. Kinsbourne, Marcel and Warrington, Elizabeth. A study of Finger Agnosia. Braun 85: 47 - 66

19. Developmental Gerstmann Syndrome. Marcel Kinsbourne. Ped. Cl. N. America. Vol. 15 N. No. 3. 1968

TABLE 1 COMPARISON OF PRESCHOOL PREDICTOR AND ACHIEVEMENT SCORES OF CHILDREN IN THREE SOCIO-ECONOMIC AREAS (SE)

VARIABLE	LOW SE	MIDDLE SE	HIGH SE	F	P
Predictors					
Stanford-Binet I.Q.	99.05	115.50	121.90	15.66	<.001
Hooper Visual Organization	15.95	19.20	17.85	5.33	<.01
Bender-Gestalt	23.95	28.85	26.55	4.47	<.05
Draw-a-Person S.S. (Harris)	85.55	93.95	98.75	5.50	<.01
Auditory Memory and Sound-blending	17.85	20.85	21.65	5.96	<.01
Kinesthetic and Tactile	17.00	18.40	18.90	3.81	<.05
Early Detection (Readiness Test)	18.53	21.35	21.20	3.58	<.05
Achievement					
Schonell Word Recognition, June 1970	9.65	20.30	27.20	18.79	<.001
Gates-McGinitie Vocabulary (Group)	25.47	37.65	43.25	15.02	<.001
Mathematics Concepts (Group)	29.06	38.45	37.85	8.96	<.001

TABLE 2

	AVERAGE MATERNAL AGE	MATERNAL EDUCATION			AVERAGE PATERNAL AGE	PATERNAL EDUCATION		
		Less than Grade 7	Finished High School	University Experience		Less than Grade 7	Finished High School	University Experience
LOW SE	28.75	6	4	0	33.05	2	5	0
MIDDLE SE	29.05	0	18	1	30.95	0	14	5
HIGH SE	30.85	0	19	11	34.70	0	18	11

TABLE 3

INCIDENCE OF COMPLICATIONS DURING
PREGNANCY, LABOR, AND NEO-NATAL PERIOD

	No. OF COMPLICATIONS	No. OF COMPLICATIONS CONSIDERED "MAJOR"	No. OF MOTHERS REPORTING COMPLICATIONS	No. OF MOTHERS REPORTING "NO COMPLICATIONS"
LOW SE	29	15	16	4
MIDDLE SE	18	3	13	7
HIGH SE	14	3	12	8
TOTALS	61	21	41	19

TABLE 4

I.Q. of children whose mothers reported "complications" compared to I.Q. of children whose mothers reported "no complications" of pregnancy labor and neo-natal period.

	I.Q "WITHOUT COMPLICATIONS"	I.Q. "WITH COMPLICATIONS"	
LOW SE	119.0	94.12	.01
MIDDLE SE	119.0	113.38	N.S.
HIGH SE	128.12	118.58	.05
ALL GROUPS	123.00	107.39	.001

TABLE 5

PREMATURITY RELATED TO I.Q.

	No. OF PREMATURES	AVERAGE I.Q. OF PREMATURES	AVERAGE I.Q. OF NON-PREMATURES	
LOW SE	6	89.3	103.28	n.s.
ALL SE	7	90.28	115.24	$p < .001$

TABLE 6

HEALTH

	No. OF POSITIVE ANSWERS TO LEADING QUESTIONS ABOUT SYMPTOMS	No. OF ABNORMAL PHYSICAL FINDINGS
LOW SE	24	7
MIDDLE SE	21 (14 "high strung")	7
HIGH SE	15	4

TABLE 7

PHYSICAL MEASUREMENTS

	AV. HEIGHT	AV. WEIGHT	AV. H.C.	AV. I.Q.	AV. SCHONELL
LOW SE	117.55 cm	21.75	50.98	99.8	9.6
MIDDLE SE	120.42 cm	21.875	51.02	115.5	20.3
HIGH SE	121.37	23.36	51.64	122.4	27.2

TABLE 8

CORRELATIONS BETWEEN PHYSICAL MEASUREMENTS

IQ, AND SCHONELL

	IQ	SCHONELL
HEAD CIRCUMFERENCE	.12	.1
HEIGHT	.27	.26
WEIGHT	.0	.01

TABLE 9

COMPARISON OF THREE SOCIO-ECONOMIC AREAS

SOME SCORES OF EXTENDED NEUROLOGICAL

V A R I A B L E	LOW SE	MIDDLE SE	HIGH SE	F	P
Total motor score	47.20	49.50	47.15	.87	n.s.
Crossing midline	4.00	4.35	4.35	.95	n.s.
Total sensory score	82.15	82.95	81.15	.33	n.s.
2 point discrimination	7.65	7.85	7.65	.48	n.s.
Visual-figure-ground	5.45	5.20	4.90	1.35	n.s.
Stereognosis	6.85	7.50	7.10	2.48	n.s.
Position sense	7.35	7.95	7.90	2.56	n.s.
Finger localization	9.15	8.60	8.80	.22	n.s
Imitation of gestures	14.60	14.00	14.00	.54	n.s.

BIBLIOGRAPHY

Belmost, Lillian and Birch, Herbert. Lateral Dominance, Lateral Awareness and Reading Disability. Albert Einstein College of Medicine: Child Devt Vol. 36 Page 1965.

Bender, L. Avisual-motor Gestalt test and its clinical use. American Orthopsychiatric Association Research Monograph, 1938, No. 3.

Benson, D. Frank M.D., and Geschwind, Norm M.D. Cerebral Dominance and its Disturbances. Ped. Cl. N. America Vol. 15 No. 3. August 1968.

Blishen, B.R. A socio-economic index for occupations in Canada. The Canadian Review of Sociology and Anthropology 1967 4, 41 - 53.

Co-operative Primary Mathematics, Form 12A Handbook Co-operative Primary Tests. Educational Testing Service, Princeton, New Jersey, 1967.

Delacato, C.H. The treatment and prevention of reading problems. The Neuropsychological approach. Springfield, Ill. Charles C. Thomas 1959.

Gates, Arthur I. and McGimitie, Walter H. Gates McGimitie Reading Tests. Teachers' Manual. New York: Teachers College Press, Columbia University, 1965.

Goodenough, F.L. The Measurement of Intelligence by Drawing. World Book Co., 1926.

Hooper R.E. The Hooper Visual-Organization Test. California: Western Psychological Service, Inc. 1957.

Kephart, N.C. The slow learner in the classroom. Columbus, Ohio. Merrill 1960.

Kinsbourne, Marcel. Developmental Gerstmann Syndrome. Ped. Cl. N. america. Vol 15. N. No. 3. 1968.

Kinsbourne, Marcel and Warrington, Elizabeth. A study of Finger Agnosia. Braun 85: 47 - 66

Lucas, Alexander, Rodin, Ernst A, Simpson, Clyde B. Neurological Assessment of Children with Early School Problems. Developmental Med. Child Neurol. 7: 145 - 156 April 1965.

McGahan, F.E. and McGahan, Carolyn. The Eartly Detection Inventory, Chicago: Follett Educational Corporation, 1967.

Ozer, M.M., A measure for neurological evaluation of school age children. Presented at a Seminar on learning difficulties at the Children's Hospital, Washington, D.C. May 1967.

Paine, Richmond S and Oppe, Thomas E. Neurological Examination of Children 1966

Schonell, Fred The psychology and Teaching of Reading. London Oliver and Boyd 4th Ed. 1961.

Terman, L.M. and Merrill, M.A. Stanford-Binet Intelligence Scale (3rd Rev) Boston Houghton-Mifflin 1960.

Whitsell, Leon J. Useful tests in Neurological Examination of School Age Children. Presented at American Academy of Pediatrics, San Francisco, California. April 5 196